SP Series 600W&1,000W Pure Sine Wave Inverter/Charger User's Manual

For Models
SP0612120
SP0612230
SP1012120
SP1012230

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1 Important Safety Information

Save This Manual! Read this manual before installation, it contains important safety, installation and operating instructions. Keep it in a safe place for future reference.
All wiring must follow the National Electric Code, Provincial or other codes in effect at the time of installation, regardless of suggestions in this manual. All wires should be copper conductors.

1.1 General Safety Precautions

1.1.1 Before installing and using the SP Series Pure Sine Wave Inverter/Charger, read the manual and cautionary markings on the Inverter/Charger enclosure. Be sure to read all instructions and cautionary markings for any equipment attached to this unit. Installers must be certified technicians or electricians.
1.1.2 This product is designed for indoor/compartment installation. Do not expose the inverter/charger to rain, snow, spray, bilge or dust. To reduce risk of hazard, do not cover or obstruct the ventilation openings. Do not install the inverter/charger in a zero-clearance compartment. Overheating may result. Allow at least one inch of clearance around the inverter for air flow. Make sure that the air can circulate freely around the unit. A minimum air flow of 145CFM is required.
1.1.3 To avoid a risk of fire and electronic shock. Make sure that existing wiring is in good electrical condition; and that wire size is not undersized. Do not operate the Inverter with damaged or substandard wiring.
1.1.4 This equipment contains components which can produce arcs or sparks. To prevent fire or explosion do not install in compartments containing batteries or flammable materials or in locations which require ignition protected equipment. This includes any space containing gasoline-powered machinery, fuel tanks, or joints, fittings, or other connection between components of the fuel system. See Warranty for instructions on obtaining service.
1.1.5 Do not dis-assemble the Inverter/Charger. It contains no user serviceable parts. Attempting to service the Inverter/Charger yourself may result in a risk of electrical shock or fire. Internal capacitors remain charged after all power is disconnected.
1.1.6 To reduce the risk of electrical shock, disconnect both AC and DC power from the Inverter/Charger before attempting any maintenance or cleaning. Turning off controls will not reduce this risk

CAUTION: Equipment damage
The output side of the inverter's AC wiring should at no time be connected to public power or a generator. This condition is far worse than a short circuit. If the unit survives this condition, it will shut down until corrections are made.
Installation should ensure that the inverter's AC output is, at no time, connected to its AC input.

WARNING: LIMITATIONS ON USE

SPECIFICALLY, PLEASE NOTE THAT THE INVERTER/CHARGER SHOULD NOT BE USED IN CONNECTION WITH LIFE SUPPORT SYSTEMS OR OTHER MEDICAL EQUIPMENT OR DEVICES. WE MAKE NO WARRANTY OR REPRESENTATION IN CONNECTION WITH THEIR PRODUCTS FOR SUCH USES. USING THE INVERTER/CHARGER WITH THESE PARTICULAR EQUIPMENTS IS AT YOUR OWN RISK.

1.2 Precautions When Working with Batteries

1.2.1 If battery acid contacts skin or clothing, wash immediately with soap and water. If acid enters eye, immediately flood eye with running cold water for at least 20 minutes and get medical attention immediately.
1.2.2 Never smoke or allow a spark or flame in vicinity of battery or engine.
1.2.3 Do not drop a metal tool on the battery. The resulting spark or short-circuit on the battery of other electrical part may cause an explosion.
1.2.4. Remove personal metal items such as rings, bracelets, necklaces, and watches when working with a lead-acid battery. A lead-acid battery produces a short-circuit current high enough to weld a ring or the like to metal, causing a severe burn.
1.2.5 To reduce the risk of injury, charge only rechargeable batteries such as deep-cycle lead acid, lead antimony, lead calcium gel cell, absorbed mat, and NiCad/NiFe or Lithium battery. Other types of batteries may burst, causing personal injury and damage.

2 Introduction

2.1 General Information

Thank you for purchasing the SP Series Pure Sine Wave Inverter/Charger.
The SP Series Pure Sine Wave Inverter/Charger is a transformer based inverter and battery charger with an unprecedented conversion efficiency of 90%.
It features power factor corrected, sophisticated multi-stage charging control and pure sine wave output with high surge capability to meet power needs of all sorts of demanding loads without putting the equipment at risk.
In response to the increasing demand of more advanced battery charging, our engineering team equipped the inverter with a Battery Temperature Sensing probe for increased charging precision.
The generous 300% surge capacity of 20 seconds makes it possible to support demanding inductive loads.
The AC/Battery priority, auto generator start functionality and optional built-in charger make it ideally suitable to work in backup power or anti-idle applications.
When customized to Battery priority mode via a DIP switch, the inverter will extract maximum power from external power sources and a minimal cycle of battery will be required. With the availability of auto generator start, an electrical generator can be integrated into the system and started when the battery voltage goes low.
With audible buzzer and remote LCD panel, the inverter gives the users comprehensive information of the operation status, making it easier for maintenance and troubleshooting.
Thus the SP Series Pure Sine Wave Inverter/Charger is suitable for applications including renewable energy systems, utility, truck, RV and emergency vehicles etc.
To get the most out of the power inverter, it must be installed, used and maintained properly. Please read the instructions in this manual before installing and operating.

2.3 Mechanical Drawing

2.4 Features

- Smart remote LCD control
- Auto Generator Start(Optional)
- Battery Temperature Sensing for increased charging precision(Optional)
- Manual 50Hz/60Hz output frequency switch
- Maximum 90% conversion efficiency
- High surge output capability, 300% peak load for 20 seconds
- Low quiescent current
- Battery type selector for 8 types of batteries and de-sulphation for completely drained batteries
- 10ms transfer time from AC to battery for continuous load operation
- 15 sec DC to AC transfer delay, improved protection for generator driven loads
- Thermally controlled variable speed fan for more efficient cooling
- Extensive protections against various harsh situations

2.5 Electrical Performance

2.5.1 Invert

Topology

The SP series pure sine wave inverter/charger is built according to the following topology.
Invert: Full Bridge Topology.
Charge: Isolated Boost Topology
When operating in invert mode, the direct current (DC) that enters the inverter from the batteries is filtered by a large input capacitor and switched “On” and “Off” by the Metal Oxide Silicon Field Effect Transistors (MOSFET) at a rate of 50 Hz or 60Hz, and directed into the transformer which steps the voltage up to 230 or 120 volts. The unit has a 16bit, 4.9MHZ microprocessor to control the output voltage and frequency as the DC input voltage and/or output load varies.
Because of high efficiency MOSFETs and the heavy transformers, it outputs PURE SINE WAVE AC.
The peak invert efficiency of SP series is 90%.

Overload Capacity

The SP series inverter/charger has different overload capacities, making it ideal to handle demanding loads.
1 For 110%<Load<125% (±10%), no audible alarm in 14 minutes, beeps 0.5s every 1s in the 15th minute, and Fault (Turn off) after the 15th minute.
2 For 125%< Load<150% (±10%), beeps 0.5s every 1s and Fault (Turn off) after the 1 minute.
3 For 300%≧Load>150% (±10%), beeps 0.5s every 1s and Fault (Turn off) after 20s.

Caution:

After the inverter is switched on, it takes 3-5 seconds for it to self diagnose and get ready to deliver full power. Hence, always switch on the load(s) after a few seconds of switching on the inverter. Avoid switching on the inverter with the load already switched on. This may prematurely trigger the overload protection. When a load is switched on, it may require initial higher power surge to start. Hence, if multiple

loads are being powered, they should be switched on one by one so that the inverter is not overloaded by the higher starting surge if all the loads are switched on at once.

2.5.2 AC Charger

The SP Series pure sine wave inverter/charger is equipped with an active PFC (Power Factor Corrected) multistage battery charger. The PFC feature is used to control the amount of power used to charge the batteries in order to obtain a power factor as close as possible to 1.

Unlike other inverters whose max charging current decreases according to the input AC voltage, SP series pure sine wave inverter/charger is able to output max charge current as long as input AC voltage is in the range of 164-243VAC(95-127VAC for 120V model), and AC freq is in the range of 48-54Hz(58-64Hz for 60Hz model).

The SP series pure sine wave inverter/charger has a very rapid charge current available, and the max charge current can be adjusted from 0%-100% via a liner switch on the DC side of the inverter. This will be helpful if this powerful charger apply charging on a small capacity battery bank.

Battery type selector			
Switch setting	Description	Boost / Vdc	Float / Vdc
0	Charger Off		
1	Gel USA	14.0	13.7
2	AGM 1	14.1	13.4
3	Lithium Ion ($LiFeP0_4$)	14.6	13.7
4	Sealed lead acid	14.4	13.6
5	Gel EURO	14.4	13.8
6	Open lead acid	14.8	13.3
7	Calcium	15.1	13.6
8	De sulphation	15.5 (4 Hours then Off)	
9	Not used		

Choosing “0” in the battery type selector will disable charging function.

There are three main charging stages:

Bulk Charging: This is the initial stage of charging. While Bulk Charging, the charger supplies the battery with controlled constant current. The charger will remain in Bulk charge until the Absorption charge voltage (determined by the Battery Type selection) is achieved.

Software timer will measure the time from charger start until the battery charger reaches 0.3V below the boost voltage, then take this time as T0 and T0×10 = T1.

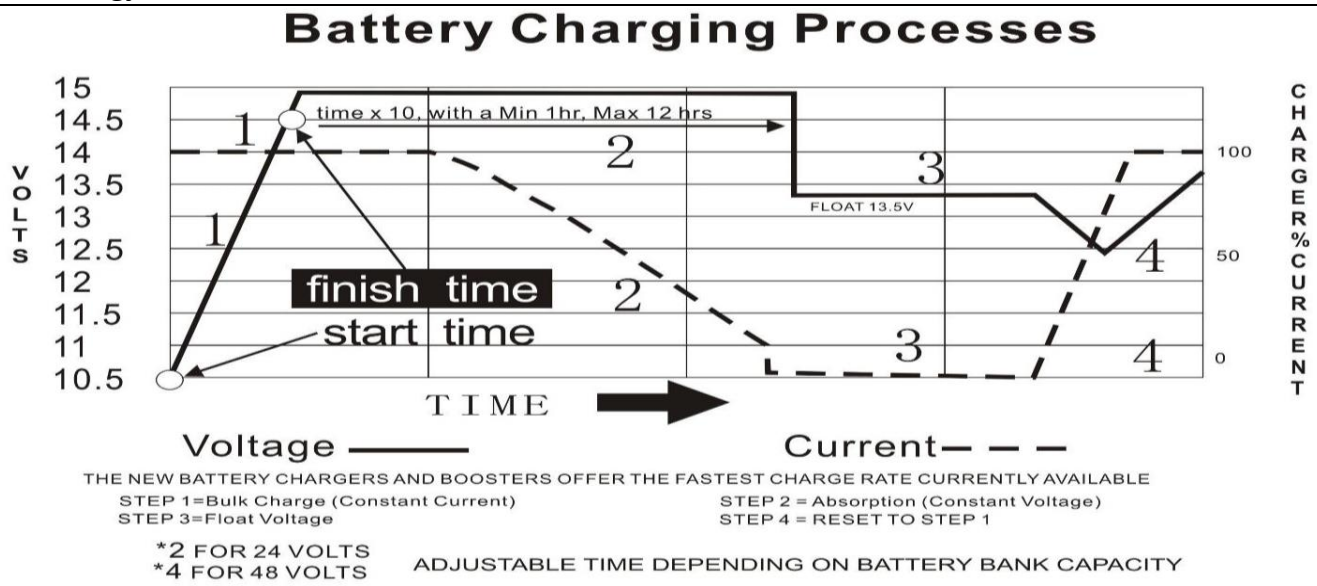
Absorb Charging: This is the second charging stage and begins after the absorb voltage has been reached. Absorb Charging provides the batteries with a constant voltage and reduces the DC charging current in order to maintain the absorb voltage setting.

In this period, the inverter will start a T1 timer; the charger will keep the boost voltage in Boost CV mode until the T1 timer has run out. Then drop the voltage down to the float voltage. The timer has a minimum time of 1 hour and a maximum time of 12 hours.

Float Charging: The third charging stage occurs at the end of the Absorb Charging time. While Float charging, the charge voltage is reduced to the float charge voltage (determined by the Battery Type selection*). In this stage, the batteries are kept fully charged and ready if needed by the inverter.

If the A/C is reconnected or the battery voltage drops below 12Vdc/24Vdc/48Vdc, the charger will reset the cycle above.

If the charge maintains the float state for 10 days, the charger will deliberately reset the cycle to protect the battery.



De-sulphation

The de-sulphation cycle on switch position 8 is marked in red because this is a very dangerous setting if you do not know what you are doing. Before ever attempting to use this cycle you must clearly understand what it does and when and how you would use it.
What causes sulphation? This occurs with infrequent use of the batteries, nor if the batteries have been left discharged so low that they will not accept a charge. This cycle is a very high voltage charge cycle especially designed to try to break down the sulphated crust that is preventing the plates from taking a charge and thus allow the plates to clean up and accept a charge once again.

Warning!

The de-sulphation charging should not be carried out on batteries with good conditions.

Charging depleted batteries

The SP series pure sine wave inverter/charger allows start up and through power with depleted batteries.
For 12VDC models, after the battery voltage goes below 10V, if the switch is still(and always) kept in "ON" position, the inverter is always connected with battery whose voltage doesn't drop below 2V, the inverter will be able to charge the battery once qualified AC inputs.
Before the battery voltage going below 9VDC, the charging can activated when the switch is turned to "Off", then to "ON".
When the voltage goes below 9VDC, and the power switch is turned to "OFF" or disconnect the inverter from battery, the inverter will not be able to charge the battery once again, because the CPU lose memory during this process.

Charging current for each model

Model Wattage	Battery Voltage	Charging Current
600W	12 Vdc	25±5 Amps
1000W	12 Vdc	40±5 Amps

The charging capacity will go to peak in around 3 seconds; this may probably cause a generator to drop frequency, making inverter transfer to battery mode.
It is suggested to gradually put charging load on the generator by switching the charging switch from min to max, together with the 15s switch delay, our inverter gives the generator enough time to spin up.

Caution:	**Please use a small jeweler's style flat-head screwdriver to turn the charge current control switch gently to avoid breakage due to over-turning.** **To guarantee the best performance of AC charger when the AC input is from a generator, the standby generator should be of at least 150% higher capacity than the inverter.** **Warning! Operation with an under-rated generator or generator with unqualified wave form may cause premature failure which is not under warranty.**

2.5.3 Transfer

While in the Standby Mode, the AC input is continually monitored. Whenever AC power falls below the VAC Trip voltage (154 VAC, default setting), the inverter automatically transfers back to the Invert Mode with minimum interruption to your appliances - as long as the inverter is turned on. The transfer from Standby mode to Inverter mode occurs in approximately 10 milliseconds. And it is the same time from Inverter mode to Standby mode.
Though it is not designed as a computer UPS system, this transfer time is usually fast enough to hold them up.
There is a 15-second delay from the time the inverter senses that continuously qualified AC is present at the input terminals to when the transfer is made. This delay is built in to provide time for a generator to spin-up to a stable voltage and avoid relay chattering. The inverter will not transfer to generator until it has locked onto the generator's output. This delay is also designed to avoid frequent switch when input utility is unstable.

2.5.4 Remote Operation

The inverter can also be connected to an external LCD display through the REMOTE LCD PORT.

The whole SP Series inverter is designed with extraordinarily low idle power consumption which is approximately 1.5% of its rated power.

SP Series Inverter/Charger Idle Power Consumption (in Watts)

Model	Power Saver Off	Power Saver Auto	
	Idle(Max)	3Secs(Max)	Unit Off Charging
600W	18W	7.5W	3W
1KW	22W	9W	

For more detailed technical information, please contact us.

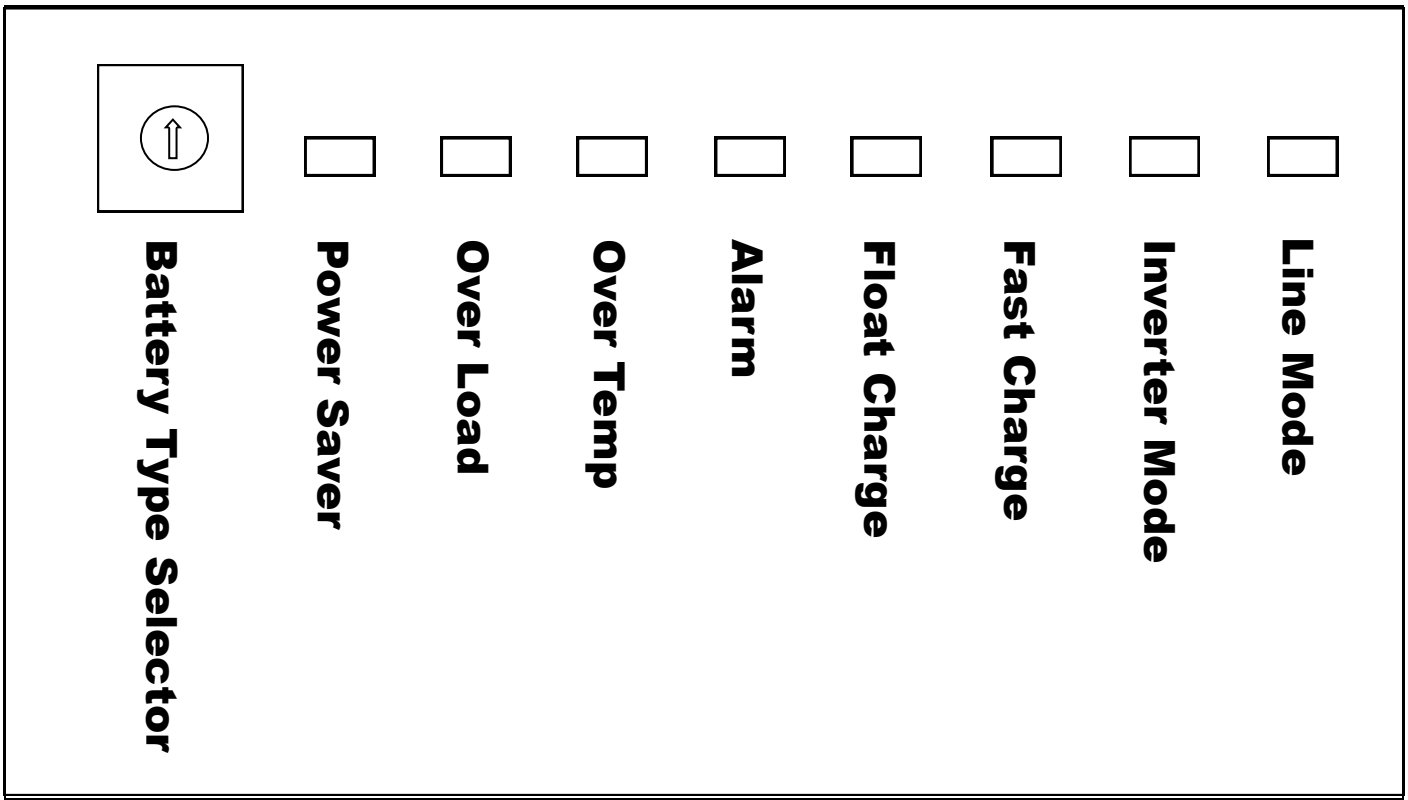
2.5.5 Protections

The SP series inverter/charger is equipped with extensive protections against various harsh situations/faults. These protections include:

- AC Input over voltage protection/AC Input low voltage protection
- Low battery alarm/High battery alarm
- Over temperature protection/Over load protection
- Short Circuit protection (1s after fault)
- Back feeding protection on the AC output

When Over temperature /Over load occur, after the fault is cleared, the master switch has to be reset to restart the inverter.
The Low battery voltage trip point can be customized from defaulted value of 10VDC to 10.5VDC through the SW1 on the DIP switch.
The inverter will go to Over-temp protection when the heat sink temps. ≥105℃ (221℉), and will go to Fault (shutdown Output) after 30 seconds. After temp drops to 90℃ (194℉), the switch has to be reset to activate the inverter.
The SP series Inverter has back feeding protection which avoids presenting an AC voltage on the AC input terminal in Invert mode.
After the reason for fault is cleared, the inverter has to be reset to start working.

2.5.7 LED Indicator



AC MODE	GREEN LED on “AC Input Mode”
INVERTER ON	GREEN LED on “Invert Mode”
FAST CHARGE	Yellow LED on “Fast CHG”
FLOAT CHARGE	GREEN LED on “Float CHG”
OVER TEMP TRIP	RED LED on “Over Temp”
OVER LOAD TRIP	RED LED on “Over Load”
CHARGING	GREEN LED on “Ready Position”

Please refer to ‘Indicator and Buzzer’ for the detailed information.

2.5.8 Audible Alarm

The inverter also gives audible alarms when the following situations occur.

Battery Voltage Low	Inverter green LED Lighting, and the buzzer beep 0.5s every 5s.
Battery Voltage High	Inverter green LED Lighting, and the buzzer beep 0.5s every 1s, and Fault after 60s.
Invert Mode Over-Load	(1)110%<load<125%(±10%), No audible alarm in 14 minutes, Beeps 0.5s every 1s in 15th minute and Fault after 15 minutes; (2)125% <load<150%(±10%), Beeps 0.5s every 1s and Fault after 60s; (3)Load>150%(±10%), Beeps 0.5s every 1s and Fault after 20s;
Over Temperature	Heat sink temp. ≥105ºC(221℉), Over temp red LED Lighting, beeps 0.5s every 1s;

2.5.9 FAN Operation

For 600W-1KW models, there is one multiple controlled DC fan.
The DC fans are designed to operate according to the following logic:

Condition	Enter Condition	Leave condition	Speed
HEAT SINK TEMPERATURE	T ≤ 60℃(140℉)	T > 65℃(149℉)	OFF
	65℃(149℉)≤ T < 85 ℃(185℉)	T ≤ 60℃(140℉) or T ≥ 85℃(185℉)	50%
	T > 85℃(185℉)	T ≤ 80℃(176℉)	100%
CHARGER CURRENT	I ≤ 15%	I ≥ 20%	OFF
	20%< I ≤ 50%Max	I≤ 15% or I > 50%Max	50%
	I > 50%Max	I ≤ 40%Max	100%
LOAD Percentage (INV MODE)	Load < 30%	Load ≥ 30%	OFF
	30% ≤ Load < 50%	Load ≤ 20% or Load ≥ 50%	50%
	Load ≥ 50%	Load ≤ 40%	100%

Allow at least 1 inch of clearance around the inverter for air flow. Make sure that the air can circulate freely around the unit.
Fan noise level <60db at a distance of 1m

2.5.10 DIP Switches

On the DC end of inverter, there are 5 DIP switches which enable users to customize the performance of the device to suit the specific configuration.

Switch NO	Switch Function	Position: 0	Position: 1
SW1	Low Battery Trip Volt	10.0VDC	10.5VDC
SW2	AC Input Range	100-135VAC 184-253VAC	90-135VAC 154-253VAC (40Hz+)
SW3	Power Saver & READY	READY	Power Saver
SW4	Output Frequency	50Hz	60Hz
SW5	Battery/AC Priority	Utility Priority	Battery Priority

Low Battery Trip Volt:
Deep discharge of the lead acid battery leads to high losses in capacity and early aging. In different applications, different low voltage disconnection level is preferred. For example, for solar application, user intended to have less DOD (Depth of Discharge) to prolong the battery cycle life (mobile application, users intend to have more DOD to reduce battery capacity and on board weight).

For 12VDC model, the Low Battery Trip Volt is set at 10.0VDC by default. It can be customized to 10.5VDC using SW1 (this is to prevent batteries from over-discharging while there is only a small load applied on the inverter).

AC Input Range:

There are different acceptable AC input ranges for different kinds of loads.

For some relatively sensitive electronic devices, a narrow input range of 184-253VAC (100-135V for 120VAC model) is required to protect them.

While for some resistive loads which work in a wide voltage range, the input AC range can be customized to 154-253VAC (90-135V for 120VAC model), this helps to power loads with the most AC input power without frequent switches to the battery bank.

In order to make the inverter accept dirty power from a generator, when the SW2 is switched to position "1", the inverter will bypass an AC input with a higher voltage(164-264Vac for 230Vac model) and wider frequency (40Hz plus for 50Hz/60Hz). Accordingly, the AC charger will also work in a higher voltage (174-254Vac for 230Vac model) wider freq range (43Hz plus for 50Hz/60Hz).

This will avoid frequent switches between battery and generator. But some sensitive loads will suffer from the low quality power.

The pros and cons should be clearly realized.

Power Saver & READY

Under the Battery Priority Mode (SW5 in position "1"), the inverter can be switched between two modes: Power Saver Mode (SW3 in position "1") and READY (SW3 in position "0"). The power Switch should be in "READY" position all the time for using these functions.

In Power Saver Mode, the inverter is initially in standby mode and sends a pulse to detect the presence of a load every 3 seconds. Each pulse lasts for 250ms. The inverter will remain in standby mode until a load has been detected. Then it will wake up from standby mode and start to invert electricity from the battery bank to supply the load. As this function is under Battery Priority, the inverter will always prefer to invert electricity from battery first even there is a qualified AC input present. Only when the battery voltage is lower than the low voltage alarm point, will the inverter switch to AC input power to charge the battery and supply the load at the same time.

This Power Saver Mode can be changed to READY mode via SW3 by switching it to "0" position. (SW5 still in "1")

In READY mode, the inverter will stay in standby mode without sensing loads. It won't output any power even if a load is turned on or a qualified AC input is present. The inverter will not perform any function and only stay idle in this mode, unless the battery voltage is low. Then it will start charging the battery. This feature is ideally suitable for applications where energy conservation is required to avoid discharging batteries.

Output Frequency:

The output frequency of the inverter can be set at either 50Hz or 60Hz by SW4.

AC/Battery Priority:

Our inverter is designed AC priority by default. This means, when AC input is present, the battery will be charged first, and the inverter will transfer the input AC to power the load. Only when the AC input is stable for a continuous period of 15 days will the inverter start a battery inverting cycle to protect the battery. After 1 normal charging cycle ac through put will be restored. For more info, please refer to our manual at AC Charging Section.

The AC Priority and Battery Priority switch is SW5. When set in battery priority, the inverter will invert from battery despite the AC input. Only when the battery voltage reaches the low voltage alarm

point(10.5Vdc for 12Vdc, 21Vdc for 24Vdc, 42Vdc for 48Vdc) will the inverter transfer to AC Input, charge battery, and switch back to battery when the battery is fully charged. This function is mainly for wind/solar systems using utility power as back up.
The AC/Battery Priority function can be activated by sliding the switch even when the inverter is in operation.

Note: In battery priority mode, when qualified AC inputs for the first time and the battery voltage is below 12.5Vdc, the inverter will go into battery priority mode only after a cycle of bulk charging and absorb charging is finished. The inverter will not go into float charging mode.

2.5.11 Auto Generator Start(Optional)

The inverter can start up a generator when battery voltage goes low.
When the inverter goes to low battery alarm, it can send a signal to start a generator, and turn the generator off after battery charging is finished.
The auto gen start feature will only work with generators which have automatic starting capability. The generator must have start and stop controls [i.e., an electric starter and electric choke (for gasoline units)], and the safety sensors to be able to start and stop automatically. There is an open/close relay, that will short circuit the positive and negative cables from a generator start control. The input DC voltage can vary, but the max current the relay can carry is 16Amp. The Auto Generator Start terminal pins are not polarized.

2.5.12 Battery Temperature Sensing(Optional)

Applying the proper charge voltage is critical for achieving optimum battery performance and longevity. The ideal charge voltage required by batteries changes with battery temperature.
When the battery voltage is over 40℃ (104℉), it will reduce the charging voltage by 0.1Vdc with every degree of temperature rise.
We recommend that you install Battery Temperature Sensors on all banks to protect your batteries and to provide optimal charging of each bank.
The battery temperature sensor mounts on the side of a battery or any other location where the precise temperature of battery can be detected such as battery mounting racks.
The following table describes approximately how much the voltage may vary depending on the temperature of the batteries.

Inverter Condition	Temperature on BTS	Charger Operation
Charger Mode	BTS ≥ 50℃(122℉)	Automatically turns off charger
	BTS ≤ 40℃(104℉)	Automatically turns on charger
Inverter Mode	40℃(104℉) ≤ BTS ≤ 50℃(122℉)	Increases the low voltage shut down point by 0.5Vdc
	BTS ≥ 50℃(122℉)	Over Temp Fault

2.5.13 Other Features

Battery voltage recovery start
After low battery voltage shut off (10V for 12V model), the inverter is able to restore to work after the battery voltage recovers to 13V (with power switch still in “On” position). This function helps to save the users extra labor to reactivate the inverter when the low battery voltage returns to acceptable range in

renewable energy systems.

WARNING

Never leave the loads unattended, some loads (like a Heater) may cause accidents in such cases.
It is better to shut everything off after low voltage trip than to leave your load in the risk of fire.

3 Installation

3.1 Location

Follow all the local regulations to install the inverter.
Please install the equipment in a location of Dry, Clean, Cool with good ventilation.
Working temperature: －10℃ to 50℃ (-14℉to 122℉)
Storage temperature: －40℃ to 70℃ (-40℉to 158℉)
Relative Humidity: 0% to 95%，non-condensing
Cooling: Forced air
Warning! Operation in a condensing environment will void the warranty.

3.2 DC Wiring Recommendation

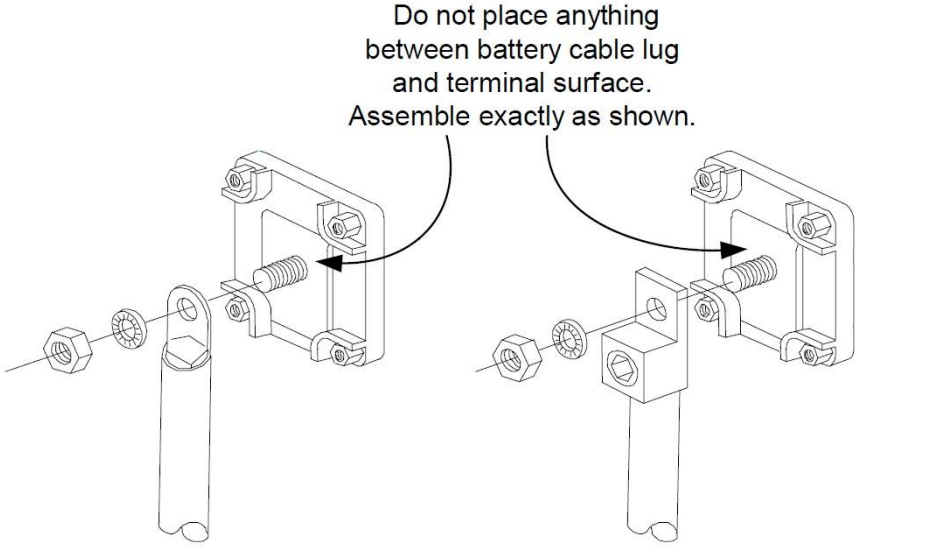
It is suggested the battery bank be kept as close as possible to the inverter. The following table is a suggested wiring option for DC cable with length from 1 meter to 5 meters.

Model Watt	Battery Voltage	Minimum Wire Gage		Model Watt	Battery Voltage	Minimum Wire Gage	
		0~15ft	15~20ft			0~15ft	15~20ft
600W	12 Vdc	8ga	6ga	1000W	12 Vdc	4ga	2ga

Please follow the above minimum wire size requirement.
One cable is always best, but if there is a problem obtaining for example 100mm ²cable, use 2*50mm ²or 3*35mm ²instead, as long as the square area adds up. Performance of any product can be improved by thicker cable and shorter runs (so if in doubt round up and keep the length as short as possible).

Battery cables must have crimped (or preferably, soldered and crimped) copper compression lugs unless aluminum mechanical lugs are used. Soldered connections alone are not acceptable.

Battery terminal must be clean to reduce the resistance between the DC terminal and cable connection. A buildup of dirt or oxidation may eventually lead to the cable terminal overheating during periods of high current draw. Use a stiff wire brush and remove all dirt and corrosion from the battery terminals and cables.



2/0 Copper Compression Lug　　2/0 Aluminum Mechanical Lug

Reducing RF interference
To reduce the effect of radiated interference, twist the DC cables. To further reduce RF interference, shield the cables with sheathing /copper foil / braiding.

Taping battery cables together to reduce inductance
Do not keep the battery cables far apart. In case it is not convenient to twist the cables, keep them taped together to reduce their inductance. Reduced inductance of the battery cables helps to reduce induced voltages. This reduces ripple in the battery cables and improves performance and efficiency.

WARNING	The torque rating range for DC terminal is 12.5NM-20.5NM (9.25-15.19 ft. lbs.), and the suggested torque rating is 17NM (12.6 ft. lbs.). Over torquing may cause the bolt to break.
	Equipment Damage The inverter is not reverse polarity protected. Reversing the battery polarity on the DC input connections will cause permanent damage to the inverter which is not covered under warranty. Always check polarity before making connections to the inverter.
	The inverter contains capacitors that may produce a spark when first connected to battery. Do not mount in a confined a battery or gas compartment.
	Ensure the inverter is off before disconnecting the battery cables, and that AC power is disconnected from the inverter input.

3.3 AC Wiring Recommendations

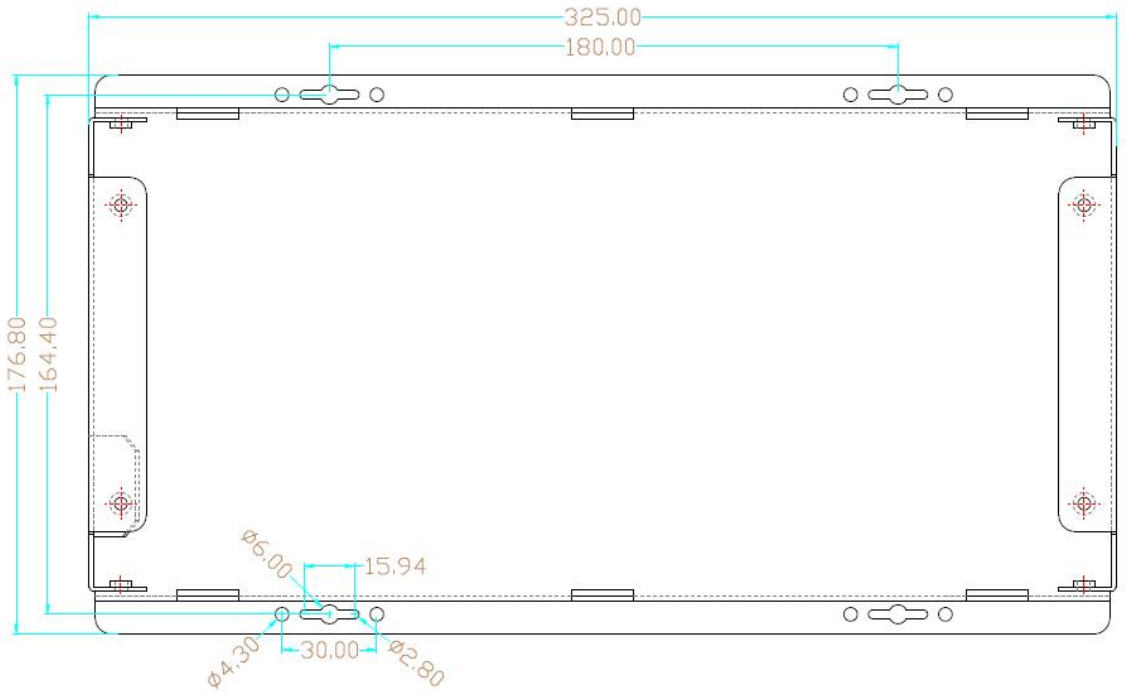
We recommend using 12 to 14 AWG wire to connect to the ac terminal block.
When in AC mode the AC input power will supply both the loads and AC charger, a thicker wire gauge for AC Input is required. Please consult a qualified electrician about the specific wire gauge required in terms of wire material and inverter power.
Please do the wiring according to local regulations, call our tech support if you are not sure about how to wire any part of your inverter.

3.4 Grounding

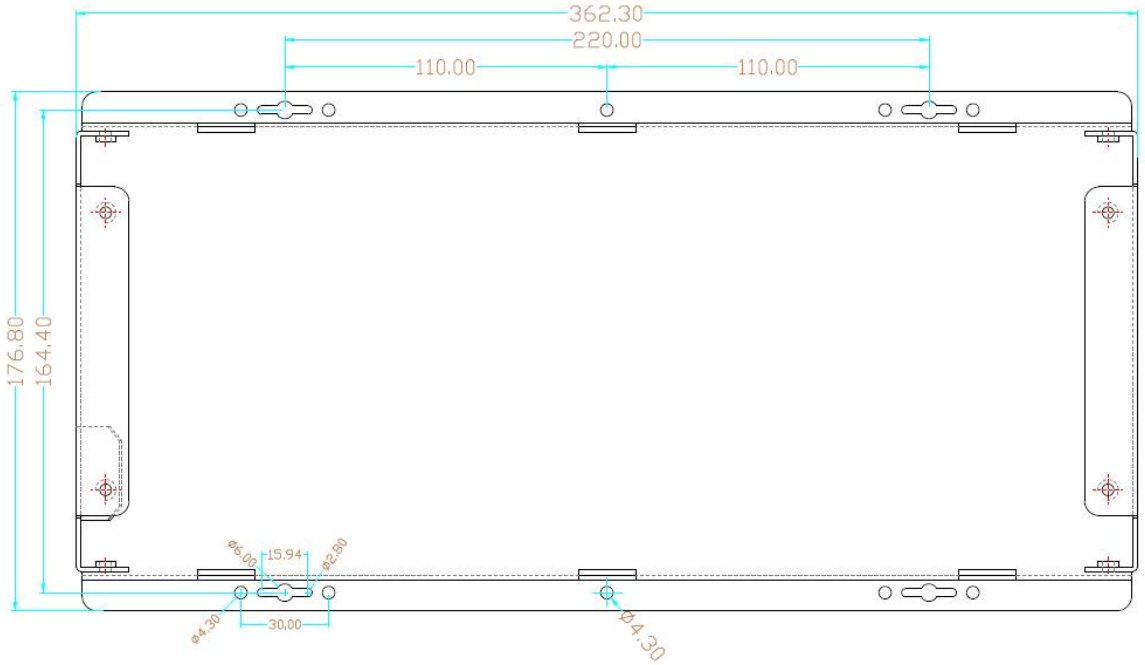
Connect an AWG 8 gauge or greater copper wire between the grounding terminal on the inverter and the earth grounding system or the vehicle chassis.

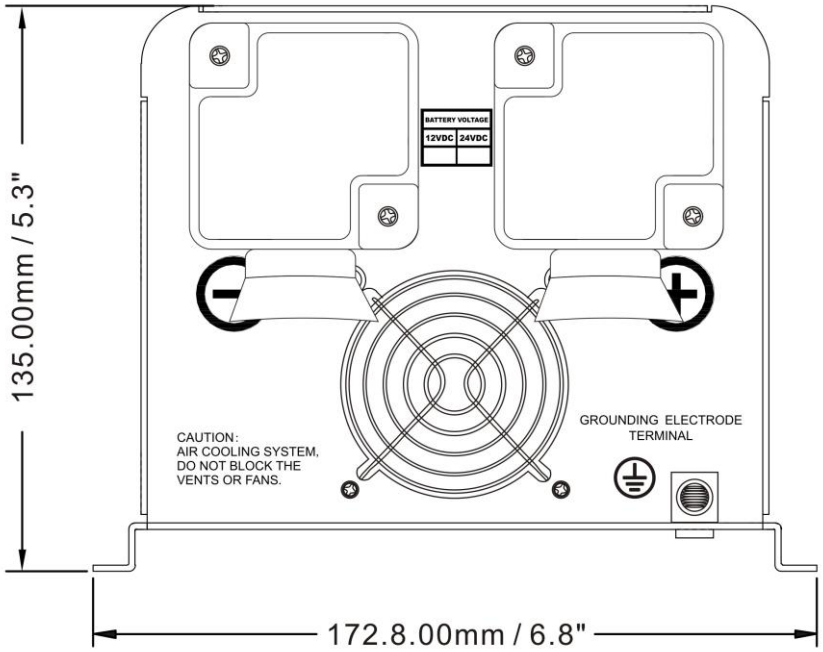
3.5 Mounting Flange

600W Model



1000W Model




135.00mm / 5.3"
BATTERY VOLTAGE
12VDC 24VDC
CAUTION:
AIR COOLING SYSTEM,
DO NOT BLOCK THE
VENTS OR FANS.
GROUNDING ELECTRODE
TERMINAL
172.8.00mm / 6.8"

End View

4 Maintenance & Troubleshooting

This troubleshooting guide contains information about how to troubleshoot possible error conditions while using the SP Pure Sine Wave Inverter/Charger.

The following chart is designed to help you quickly pinpoint the most common inverter failures.

Indicator and Buzzer

		Indicator on top cover							LED on Remote Switch			
Status	**Item**	AC Line Mode ON	INVERTER ON	FAST CHG	FLOAT CHG	OVER TEMP TRIP	OVER LOAD TRIP	READY ON	BATT CHG	INVERTER	Alarm	Buzzer
Line Mode	CC	√		√					√			
	CV	√		√, blink					√			
	Float	√			√				√			
	Standby	√										
Inverter Mode	Inverter On		√							√		
	Power Saver							√				
Inverter Mode	Battery Low		√							√	√	Beep 0.5s every 5s
	Battery High		√							√	√	Beep 0.5s every 1s
	Overload On Invert Mode		√				√			√	√	Refer to “Audible alarm”
	Over-Temp On Invert Mode		√			√				√	√	Beep 0.5s every 1s
	Over-Temp On Line Mode	√		√		√			√		√	Beep 0.5s every 1s
	Over Charge	√		√					√		√	Beep 0.5s every 1s
Fault Mode	Fan Lock											Beep continuous
	Battery High		√							√		Beep continuous
	Inverter Mode Overload						√					Beep continuous
	Output Short						√				√	Beep continuous
	Over-Temp					√						Beep continuous
	Over Charge			√					√			Beep continuous
	Back Feed Short											Beep continuous

Symptom	Possible Cause(s)	Recommended Solution(s)
Inverter will not turn on during initial power up.	Batteries are not connected, loose battery-side connections. Low battery voltage.	Check the batteries and cable connections. Check DC fuse and breaker. Charge the battery.
No AC output voltage and no indicator lights ON.	Inverter has been manually transitioned to OFF mode.	Press the switch to Power saver on or Power saver off position.
Inverter overload indicator on	Excessive AC output load or AC output short Defective inverter	Check AC output loads and wiring
Inverter high temperature indicator on	Excessive ambient temperature or AC output load	Check AC output loads, increase ventilation, derate the inverter if ambient temperature is excessive.
AC output voltage is low and the inverter turns loads OFF in a short time.	Low battery.	Check the condition of the batteries and recharge if possible.
Charger is inoperative and unit will not accept AC.	AC voltage has dropped out-of-tolerance	Check the AC voltage for proper voltage and frequency.
Charger is supplying a lower charge rate.	Charger controls are improperly set. Low AC input voltage. Loose battery or AC input connections.	Refer to the section on adjusting the “Charger Rate”. Source qualified AC power.. Check all DC /AC connections.
Charger turns OFF while charging from a generator.	High AC input voltages from the generator.	Load the generator down with a heavy load. Turn the generator output voltage down.
Sensitive loads turn off temporarily when transferring between grid and inverting.	Inverter's Low voltage trip voltage may be too low to sustain certain loads.	Choose narrow AC voltage in the DIP switch, or Install a UPS if possible.
Noise from Transformer/case*	Applying specific loads such as hair drier	Remove the loads

***The reason for the noise from transformer and/or case**

When in inverter mode and the transformer and/or case of the inverter sometimes may vibrate and make noise. The noise may come from transformer.

According to the characteristics of our inverter, there is one type of load which will most likely cause rattles of the transformer, that is a half-wave load, load that uses only a half cycle of the power(see figure 1). This tends to cause imbalance of magnetic field of transformer, reducing its rated working freq from 20 KHz to, say, maybe 15 KHz (it varies according to different loads). This way, the freq of noise falls exactly into the range (200Hz-20 KHz) that human ear can sense.

The most common load of such kind is hair drier.
If the noise is coming from the case;
Normally when loaded with inductive loads, the magnetic field generated by transformer keeps attracting or releasing the steel case at a specific freq, this may also cause noise.
This noise may also be generated the moment a load is detected in the power saver mode.
Reducing the load power or using an inverter with bigger capacity will normally solve this problem.
The noise won't do any harm to the inverter or the loads.

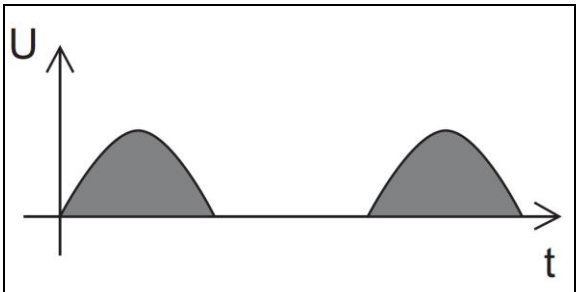


Figure 1
Half Cycle Load Waveform

5 Warranty

We warrant this product against defects in materials and workmanship for a period of two years from the date of purchase and will repair or replace any defective SP Inverter when directly returned, postage prepaid, to manufacturer. This warranty will be considered void if the unit has suffered any obvious physical damage or alteration either internally or externally and does not cover damage arising from improper use such as plugging the unit into an unsuitable power sources, attempting to operate products with excessive power consumption requirements, reverse polarity, or use in unsuitable climates.
WARRANTY DOES NOT INCLUDE LABOR, TRAVEL CHARGES, OR ANY OTHER COSTS INCURRED FOR REPAIR, REMOVAL, INSTALLATION, SERVICING, DIAGNOSING OR HANDLING OF EITHER DEFECTIVE PARTS OR REPLACEMENT PARTS. THE WARRANTOR ASSUMES NO LIABILITY FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY KIND.
LOSS OR DAMAGE: Loss or damage in transit is the responsibility of the carrier. Any claim should be filed with the delivering transport company. Invoice, Bill of Lading and Delivery receipt with damage noted therein must accompany any claims for freight damage. Claims for shortage and lost shipments must be made in writing to the shipper within 3 days of the receipt of shipment. Claims not reported within this time frame will not be honored.
This warranty does not apply to and we will not be responsible for any defect in or damage to:
a) the product if it has been misused, neglected, improperly installed, physically damaged or altered, either internally or externally, or damaged from improper use or use in an unsuitable environment; violations of the warnings in the manual will invalid the warranty.
b) the product if it has been subjected to fire, water, generalized corrosion, biological infestations, or input voltage that creates operating conditions beyond the maximum or minimum limits listed in the product specifications including high input voltage from generators and lightning strikes;
c) the product if repairs have been done to it other than by our company or its authorized service centers

6 Model Numbering

The Smart Power series Inverter is identified by the model/serial number labels. Model Number label is located on the side of the cover. All the necessary information is provided on the label such as battery voltage, AC output voltage, power and frequency.
For example

Model Number	Power	Battery voltage	AC voltage	Phase
SP0612120	600W	12Vdc	120Vac	Single phase
SP1012230	1000W	12Vdc	220Vac	Single phase

Appendix 1 : SP Series Inverter/Charger Spec Sheet

Electrical Specifications			
	Power Rating	600W	1000W
Inverter Output	Continuous Output Power	600W	1000W
	Surge Rating(20s)	1800W	3000W
	Output Waveform	Pure Sine wave/Same as input(Bypass mode)	
	Nominal Efficiency	90%(Peak)	
	Line Mode Efficiency	>95%	
	Power Factor	0.9-1.0	
	Nominal Output Voltage RMS	120Vac	
	Output Voltage Regulation	±5% RMS	
	Output Frequency	50/60Hz ±0.3Hz	
	Short Circuit Protection	Yes, Current Limit Function (Fault after 1sec)	
	Typical transfer Time	10ms(Max)	
	THD	Pure sine wave, less than 5% THD Typical	
DC Input	Nominal Input Voltage	12.0Vdc	
	Minimum Start Voltage	10.0Vdc	
	Low Battery Alarm	10.5Vdc / 11.0Vdc (Dependent on switch setting)	
	Low Battery Trip	10.0Vdc / 10.5Vdc (Dependent on switch setting)	
	High Voltage Alarm & Fault	16.0Vdc	
	High DC Input Recovery	15.5Vdc	
	Low Battery Voltage Recover	13.0Vdc	
	Idle Consumption-Search Mode	< 25 W when Power Saver On	
AC Charge	Input Voltage Range	Narrow: 100~135VAC;	
		Wide: 90~135VAC ;	
	Input Frequency Range	Narrow: 47-55±0.3Hz for 50Hz, 57-65±0.3Hz for 60Hz	
		Wide:43±0.3Hz plus for 50Hz/60Hz	
	Output Voltage	Depends on battery type	
	Charger Breaker Rating(120Vac)	7A	10A
	Max Charge Rate	25A +/-5A	45A +/-5A
	Over Charge Protection Shutdown	15.7V for 12Vdc	
	Battery type	Fast Vdc	Float Vdc
	Gel U.S.A	14	13.7
	A.G.M 1	14.1	13.4
	Lithium Ion ($LiFeP0_4$)	14.6	13.7
	Sealed Lead Acid	14.4	13.6
	Gel Euro	14.4	13.8
	Open Lead Acid	14.8	13.3
	Calcium	15.1	13.6
	De-sulphation	15.5 for 4hrs	
	Remote Control	Yes. Optional	
	Input Voltage Waveform	Sine wave (Grid or Generator)	
	Nominal Voltage	120Vac/230Vac	

	Low Voltage Trip	80Vac/154Vac ±4%	
	Low Voltage re engage	90Vac/164Vac ±4%	
	High Voltage Trip	140Vac/253Vac ±4%	
	High Voltage re engage	135Vac/243Vac ±4%	
	Max Input AC Voltage	150Vac/270VAC	
	Nominal Input Frequency	50Hz or 60Hz (Auto detect)	
	Low Frequency Trip	Narrow: 47 ±0.3Hz for 50Hz, 57 ±0.3Hz for 60Hz	
		Wide:40 ±0.3Hz for 50Hz/60Hz	
	Low Frequency re-engage	Narrow: 48 ±0.3Hz for 50Hz, 58 ±0.3Hz for 60Hz	
		Wide:45 ±0.3Hz for 50Hz/60Hz	
	High Frequency Trip	Narrow: 55 ±0.3Hz for 50Hz, 65 ±0.3Hz for 60Hz	
		Wide: No up limit for 50Hz/60Hz	
	High Frequency re-engage	Narrow: 54 ±0.3Hz for 50Hz, 64 ±0.3Hz for 60Hz	
		Wide: No up limit for 50Hz/60Hz	
Mechanical Specification	Mounting	Wall mount	
	Inverter Dimensions(L*W*H)	325x173x135mm/ 12.8x6.8x5.3"	362x173x135mm/ 14.3x6.8x5.3"
	Inverter Weight	7.5KG/16.5lb	11KG/24.3lb
	Shipping Dimensions(L*W*H)	435x230x205mm/ 17.1x9x8"	475x230x205mm/ 18.7x9x8"
	Shipping Weight	8.5KG/18.7lb	12KG/26.5lb
	Display	Status LED	
	Standard Warranty	2 Year	

※Errors and omissions reserved. Specifications in this manual are subject to change without prior notice.